[0015] Still further in accordance with embodiments of this invention there is provided a touch screen system that includes a semi-transparent translucent screen; an image capture device located for imaging a first side of the screen opposite a second side whereon a user touches the screen; at least one light source disposed for illuminating the first side of the screen and providing an illumination differential between the first side and the second side; and an image processor coupled to the output of the image capture device to determine at least one of where and when the user touches an area on the second side of the screen by a change in intensity of light emanating from the touched area relative to a surrounding area. When incident light on the second side of the screen is brighter than incident light on the first side of the screen, an image of the point of contact with the screen is silhouetted and appears darker than the surrounding area, while when incident light on the first side of the screen is brighter than incident light on the second side of the screen, an image of the point of contact with the screen is highlighted and appears brighter than the surrounding area.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The foregoing and other aspects of these teachings are made more evident in the following Detailed Description of the Preferred Embodiments, when read in conjunction with the attached Drawing Figures, wherein;

[0017] **FIG. 1** is a simplified system level block diagram of a touch-based input apparatus.

[0018] **FIG. 2** shows results of an image difference process under different front/rear ambient light conditions.

[0019] **FIG. 3** is a logic flow diagram of one cycle of a touch event detection image processing procedure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] **FIG. 1** shows the basic structure of a presently preferred embodiment of a user input system **10** under and two situations of input. The input system **10** includes a translucent screen **12**, and an image capture device such as a video camera **14** that is positioned on a first side **12**A, also referred to herein for convenience as a "rear" side, of the screen **12**. A user is assumed to be positioned relative to a second side **12**B of the screen **12**, also referred to herein for convenience as the "front" side of the screen **12**. There is at least one rear light source **16** and possibly at least one front light source **18** that are arranged for illuminating the rear side **12**A of the screen **12** and front side **12**B of the screen **12**, respectively. It is assumed that there is a data processor **20** having a memory **22** arranged for receiving image data output from the camera **14**. The data processor **20** could be a stand-alone PC, or a processor embedded in the camera **14**, and it may be co-located with the camera **14** or located remotely therefrom. A link **21** between the camera **14** and the data processor **20** could be local wiring, or it could include a wired and/or a wireless connection, and at least part of the link **21** may be conveyed through a data communications network, such as the Internet. The memory **22** can store raw image data received from the camera **14**, as well as processed image data, and may also store a computer program operable for directing the data processor **20** to execute a process that embodies the logic flow diagram shown in **FIG. 3**, and described below. The memory **22** can take any suitable form, and may comprise fixed and/or removable memory devices and medium, including semiconductor-based and rotating disk based memory medium.

[0021] The data processor **20** can digitize and store each frame captured by the camera **14** (if the camera **14** output is not a digital output). As will be described below, the data processor **20** also process the imagery by comparing two consecutive frames following the process shown in **FIG. 3**. Although there may be changes in the light environment on one or both sides of the screen **12**, the change caused by user contact with the screen **12** is normally very strong and exhibits clearly defined boundaries. By using computer vision techniques such as thresholding, it becomes possible to detect the characteristic changes caused by the user touching the screen (either directly or through the use of a pointer or stylus or some other object).

[0022] The screen **12** could form, or could be a part of, as examples a wall, a floor, a window, or a surface of furniture. The screen **12** could be flat, curved and/or composed of multiple surfaces, adjacent to one another or separated form one another. The screen **12** could be composed of, by example, glass or a polymer. The detection of the user input may be associated with an object positioned on the front, rear, or in close proximity to the screen **12**.

[0023] For the purposes of describing the presently preferred embodiments of this invention a translucent surface, such as at least one surface of the screen **12**, transmits light, but causes sufficient scattering of the light rays so as to prevent a viewer from perceiving distinct images of objects seen through the surface, while yet enabling the viewer to distinguish the color and outline of objects seen through the surface. The screen **12** is herein assumed to be a "translucent screen" so long as it has at least one major surface that is translucent.

[0024] In accordance with embodiments of this invention, and in an input scenario or situation A, the user's hand is assumed to not touch the screen **12**, specifically the front side **12**B. In situation A, the dashed line **A1** coming to the camera **14** corresponds to the main direction of the light coming from the image of the user's finger as seen by the camera **14** (point A). The dashed line arriving at the origin on the translucent screen **12** corresponds to the light coming from the front light source(s) **18**. The light on the rear side **12**A of the screen at point A in situation A is the sum of the light coming the front source(s) **18** which, due to the translucency effect in this case, is scattered uniformly in multiple directions on the rear side **12**A of the screen **12**. Light from the rear source(s) **16** is instead reflected by the screen **12**. Therefore, in situation A, the image obtained by the camera **14** that corresponds to the position of the user's finger (point A) includes contributions from both the front light source(s) **18** (scattered in this case), and the rear light source(s) **16** (reflected).

[0025] In a second input scenario or situation B the user's hand (e.g., the tip of the user's index finger) is assumed to be touching the front surface **12**B of the screen **12**. In situation B, the line coming to the camera **14** from the user's finger touch-point (point B) corresponds to the main direction of the light coming from point B to the camera's aperture. Since the user's finger is in contact with the translucent screen **12**, the light originating from the front